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Willingness to Pay for Renewable Energy: Evidence from Malaysian's Households

(Kesanggupan Membayar terhadap Tenaga Boleh Diperbaharui: Kajian Kes Isi Rumah di Malaysia)

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ABSTRACT

The growing consumption of fossil energy fuels that is linked with climate change and quality of life has pushed renewable energy development into the centre of debate on energy security. Renewable energy has become a top priority for the governments in most countries due to its distinctive features of a cleaner energy source. Despite Malaysia's effort to encourage the various forms of renewable energy (RE), the total amount of RE is still very low. Moreover, difficulties arise as the energy supply is highly related to the general wellbeing of the individuals and societies. As such, exploring the consumer's willingness for RE has become vital as this new knowledge can be used by the government to promote long run RE consumption. This study attempts to investigate consumers' WTP for RE sources and discover other factors of WTP with special attention to Malaysia setting. By employing a contingent valuation method (CVM), the findings reveal that the willingness to pay (WTP) for RE is significantly related to the proposed bid price and household income. The results also indicate that consumer on average is willing to pay about RM3.22 (USD0.82) per month for the Renewable Energy Fund. This micro-level investigation can be a useful framework in organising information on how consumers are willing to contribute towards the development of RE in Malaysia.

Keywords: Willingness to pay; renewable energy fund; renewable energy; contingent valuation; Malaysia

ABSTRAK

Penggunaan yang semakin meningkat bagi bahan bakar tenaga fosil, yang dikaitkan dengan perubahan iklim dan kualiti hidup, mendorong kepada pembangunan tenaga boleh diperbaharui dalam konteks keselamatan tenaga. Tenaga boleh diperbaharui telah menjadi keutamaan bagi kebanyakan negara kerana ciri khasnya iaitu sumber tenaga yang lebih bersih. Sehingga kini, Malaysia mempromosikan pelbagai bentuk tenaga boleh diperbaharui tetapi jumlah tenaga boleh diperbaharui masih rendah. Selain itu, kesukaran timbul kerana bekalan tenaga sangat berkaitan dengan kesejahteraan umum individu dan masyarakat. Oleh itu, ia menjadi penting untuk meneroka kesediaan pengguna untuk tenaga boleh diperbaharui di mana pengetahuan baru ini boleh digunakan oleh kerajaan untuk menggalakkan penggunaan tenaga boleh diperbaharui dalam jangka masa panjang. Kajian ini cuba untuk melihat kesanggupan membayar (WTP) pengguna untuk sumber tenaga boleh diperbaharui. Selain daripada itu, kajian ini turut mengkaji faktor-faktor lain yang mempengaruhi WTP dalam konteks pengguna di Malaysia. Dengan menggunakan kaedah penilaian kontingen (CVM), penemuan menunjukkan bahawa kesanggupan untuk membayar (WTP) bagi tenaga boleh diperbaharui adalah berkaitan dengan harga bidaan yang dicadangkan dan pendapatan isi rumah. Hasilnya juga menunjukkan bahawa secara purata pengguna sanggup membayar kira-kira RM3.22 (USD0.82) sebulan untuk Dana Tenaga Diperbaharui. Kajian pada peringkat mikro ini boleh menjadi rangka kerja yang berguna untuk memberikan maklumat bagaimana pengguna sanggup memberi sumbangan kepada pembangunan tenaga boleh diperbaharui di Malaysia.

Kata kunci: Kesediaan untuk membayar; dana tenaga boleh diperbaharui; tenaga boleh diperbaharui; penilaian kontigen; Malaysia

INTRODUCTION

Over the past three decades, fossil fuels comprising coal, natural gas and petroleum have been an essential ingredient in most sectors of the existing economies. Fossil fuels are the main sources for electricity generation, which is vital in all sectors of life including the residential, administration, business, industrial, transportation and services. According to the data published by the International Energy Agency (IEA), the global total primary energy supply has increased by almost 150% between 1970 and 2013 (IEA 2015). In

addition, as the economies in most developing countries continue to experience economic growth and relatively fast development, the demand for energy is likely to increase extensively due to the shifts towards energy-intensive activities.

In Malaysia, primary energy consumption has increased from 861.98 kg of oil equivalent per capita in 1980 to 2967.54 kg of oil equivalent per capita in 2014 (WDI 2018). The increase is mainly caused by the dependency of Malaysia's economic growth on energy consumption, which mainly comes from the traditional energy sources (Chandran et al. 2010; Rahman et al. 2017). Accordingly, the dependency on fossil fuels in energy consumption drives the continuous rise in carbon dioxide (CO_2) emissions. CO_2 emission has increased from 2.03 metric tons per capita in 1980 to 8.03 metric tons per capita in 2014, a growth of over 295% (WDI, 2018). The extensive use of energy from fossil fuels is twofold. First, it contribute to global climate change and second, it leads to further negative impacts such as health problems, destruction of nature, landscapes, biodiversity and energy security struggle.

Given the growing prominence of energy-related emissions and other negative impact of energy consumption, any serious effort to mitigate greenhouse gases (GHGs) emissions will have to either reduce fossil fuel consumption or increase the use of cleaner energy sources. However, this scenario puts pressure on Malaysia as a developing country that is transitioning to become a fully developed country as higher energy resources are required to achieve higher living standards. High fossil fuel reliance and population levels further upsurge this pressure. Thus, reducing the pressure on fossil fuel resources to ensure better environmental quality and attain the energy security, a shift from the traditional to renewable energy is inevitable.

In this perspective, renewable energy sources have the potential to solve the problem due to its distinctive features of being cleaner sources for energy which is inexhaustible and insusceptible to energy security issues. For the past thirty years, the Malaysian government has been implementing energy policy such as the 'Four Fuel Diversification Policy', 'Fifth Fuel Diversification Policy' and the 'Renewable Energy Act 2011' with the main objectives to ensure energy security, utilise energy derived from renewable sources and increase the share of renewable energy in electricity production, respectively. The Feed-in-Tariff (FiT) mechanism was established under the Renewable Energy Act to provide for the establishment and implementation of a special tariff system to facilitates the generation of RE (Petinrin & Shaaban 2015). In line with the aim of the Malaysian government through the 11th Malaysia Plan, the country is targeting a 33% reduction in greenhouse gas emissions intensity of GDP compared to the 2005 levels as of 2013 (Eleventh Malaysia Plan 2015). Malaysia is also targeting to achieve 2080MW or 11% of electricity produced from renewable energy sources by 2020 and 4000MW or 17% by 2030 (Economic Planning Unit Malaysia 2015).

Although the government has designed numerous policies to support the development of cleaner energy sources, Malaysia is facing serious challenge on how to upsurge the contribution of renewable energy in the energy mix. At the conference of Parties in Copenhagen, Malaysia has pledged to reduce 40% carbon emission by the year 2020 from the base year 2005 (COP 15 2009). Nevertheless, the progress of renewable energy is relatively slow, where only 1% of the total energy mix being renewable (Chua et al. 2011; Oh et al. 2010,). As of 2014, RE sources contributed 243.4MW or 1% of the total installed capacity in Peninsular Malaysia and Sabah and this initiative reduced GHGs emission by 432,000tCO2eq (11th Malaysia Plan). One of the possible reasons of this low percentage of renewable energy is the fact that production of renewable energy is more expensive than fossil fuel energy. Moreover, a continuous increase in renewable energy supply will effect in an increase of production costs for most renewable energy sources. According to REN21 (2015), global investment in renewable energy technologies has scaled to more than 270 billion US$ in 2014, an increment of 21% from 2013 (214 billion US$ in year 2013).The production costs for renewable energy are expected to remain high in the future.

So far, investigations have been concentrated on producer's perspective such as green energy firms (Ng & Zheng 2018) and green energy sector (Conte & Jacobsen 2016). Less is known about green energy consumer, especially in the case of developing countries (Al-Mulali et al. 2013; Sebri & Ben-Salha 2014). Since the production of renewable energy is more expensive than fossil fuel energy, a continuous increase in renewable energy supply will result in an increase of the production costs for renewable energy sources. Apart from the large cost imposed on the producers and suppliers, the costs may also be passed onto the consumers. Therefore, there is a need to understand how consumers react towards the development of clean energy which leads to the improvement of quality of life and climate change. Identifying the fundamental issues of these linkages from the consumer's perspective will help the government to establish a better national energy policy. The outcomes of this study can posit directions to improve policy on renewable energy in order to address new issues that threaten the nation's energy security.

With this background, it is crucial to understand public's acceptance and preferences for clean energy development in this nation. Success of energy and environmental policies depends largely on the support from not only the private sector and government but also from the consumers. Therefore, the purpose of this study is to explore the consumers' WTP to use renewable energy sources in the electricity production. In this study, the contingent valuation method (CVM) was applied to

investigate the consumers' willingness to pay (WTP) for renewable energy of an individual. This study also aims to analyse the possible determinants which may affect consumer's WTP for renewable energy.

The rest of the paper is structured as follows. The following section provides a brief literature of contingent valuation method (CVM) and related studies on the WTP for renewable energy. Section Three describes the data sources and methodology. This is followed by Section Four, which presents the findings while Section Five concludes with policy implications and recommendations for future research.

LITERATURE REVIEW

Since residential sector is a substantial energy consumer in most countries in the world, many recent studies have focused on the association between greenhouse gas emissions and energy consumption in the residential sector. As described by Oladokun and Odesola (2015), studies in household energy consumption falls within the disciplinary and integrated domains. Over the years, studies relating to this association have been dominated by economics, social science and engineering frameworks. Among those studies are the works of Pablo-Romero et al. (2017), Baul et al. (2018) and Damette et al. (2018). With regard to the literature on green energy consumption, there is little information from the consumer's perspective especially in the developing countries. Although considerable research has been devoted to green energy firms (Ng & Zheng 2018) and green energy sectors (Conte & Jacobsen 2016), rather less attention has been paid to green energy consumer.

In a few studies, researchers have examined the societal acceptance of renewable energy in Malaysia. These studies suggest that the majority of respondents are highly interested in solar energy in Malaysia (Solangi et al. 2015) and almost 83% of the respondents supported the implementation of the marine renewable energy in Malaysia (Lim & Lam 2014). However, Kardooni et al. (2016) reported that population of Peninsular Malaysia showcases negative attitude towards the use of renewable energy technology. Since residential energy consumption is a complex issue highly related to the public's behaviour and acceptance in using renewable energy (Swan, et al. 2009), therefore, it is crucial to understand the role of public perception and awareness in facilitating more successful renewable energy policy.

In the context of the Contingent Valuation Method (CVM), it has been renowned as the most prevalent method applied by scholars in the field of environmental and resource economy (Guo et al. 2014). Over the past thirty years, the application of this method to assess the willingness to pay has been broadly used in numerous different situations in many countries. In general, this method is used to estimate the value that an individual consumer places on non-marketable good whereby the price of the good is unidentified. The ability of CVM to capture the non-use values has put the method as the most popular technique (Soon & Ahmad, 2015), in addition to the useful economic information it acquires. Such economic information can be used for various purposes including political analysis and litigation purpose. However, Oerlemans et al. (2016) pointed out a few limitations of the method including the biases in the start point, hypotheses, and elicitation effects. Despite the limitations, the CV method is still vastly used as it is deemed as easier and capable to attain consumer information that may not be readily available.

With regards to the study of CVM for renewable energy, the research tends to focus on industrialised countries (see Herbes et al. 2015; Mozumder et al. 2011; Rommel et al. 2016; Zografakis et al. 2010). Existing research generally supports that people are willing to pay extra for renewable energy sources. Herbes et al. (2015) conducted a comprehensive study with respect to public's willingness to pay for green electricity in Germany and found the consumers are willing to pay more for green electricity product. Zografakis et al. (2010) used a double bound dichotomous choice (DBDC) to analyse consumer willingness to pay for extra renewable energy supply. They found positive support from the consumers with an estimated median WTP value of EUR 16.33 to be paid as an extra charge on the electricity bill. Soliño et al. (2010) used the CVM to assess whether consumers are willing to support the renewable energy sources in Spain. They also found a positive WTP and the average willingness to pay estimated by this study was EUR 38 per year. These studies suggest that residents in most of developed countries are willing to contribute to the renewable energy resources in their countries.

While there are numerous studies focusing on the valuation of renewable energy sources in industrialised economies, little is known about this issue in developing countries. The literature on WTP for renewable energy in developing countries, particularly in Malaysia has been limited. As of date, CVM literatures based in Malaysia has been widely conducted in the field of tourism (Herman et al. 2014; Zaiton et al. 2012), eco-product valuation (Rezai et al. 2013; Tsen et al. 2006; Zainalabidin et al. 2014), transportation (Mahirah et al., 2015) and water service (Mahirah et al., 2017). Although there was an attempt to examine the WTP for renewable energy by Lim and Lam (2014), the study only investigated whether the consumers are willing to pay for green electricity. The survey only required the respondents to respond the WTP question with two possible outcomes ('yes' or 'no' answer). They reported that 56.8% of Malaysian are unwilling to pay for renewable energy. Therefore, the quantitative valuation for this study could not be assessed due to the missing part of the CVM approach for green electricity. Meanwhile, Kardooni et al. (2016) addressed the issue of renewable energy acceptance in Peninsular

Malaysia and found that the majority of Malaysians are concerned about climate change. Again, no quantitative response on the WTP was reported in this study.

METHODOLOGY

SAMPLING PROCEDURE

In order to elucidate the willingness to pay for renewable energy, data were gathered via questionnaire. Respondents were administered via a face-to-face survey, during the period from April to June 2016. Sample of respondents of this study were the residential users of electricity in Kuala Terengganu and Kuala Nerus, Terengganu. The state of Terengganu was selected for the study as it is not only one of the largest petroleum (non-renewable energy) producing states in Malaysia besides Sarawak, Sabah and Kelantan, but it is also rich in oil and gas reserves. In particular, Kuala Terengganu including Kuala Nerus were recorded to have the highest number of electricity utilisation compared to other districts in Terengganu with the capacity of 62, 122, 745KW (UPEN, 2015). Therefore, it is interesting to investigate the role of consumers in the development of renewable energy in Malaysia, especially in the case of petroleum producing state as a starting point for this type of study to be conducted in Malaysia.

According to the data obtained from the Population Census Report (2010), the total number of households in Kuala Terengganu (including Kuala Nerus) was 382,652 in 2010. The total number of households included in this survey was determined using Krejcie and Morgan's (1970) table. Based on the table, 384 households will be selected for the survey. Nevertheless, this study utilised data from 411 respondents involved in the survey. The sample size table is formulated based on the formula shown in Eq.1 (Krejcie & Morgan 1970):

$$S = \frac{X^2 NP(1-P)}{d^2(N-1)} + X^2 P(1-P) \qquad (1)$$

where, S is the required sample size, X^2 refers to the table value of chi-squared for 1 degree of freedom at the desired confidence level (3.841), N is a population size, P is the population proportion (assumed to be 0.5 (50%) since this would provide the maximum sample size, and d refers to the degree of accuracy expressed as a proportion (0.05).

QUESTIONNAIRES DESIGN

The purpose of this study was not only to investigate the consumers' WTP for renewable energy but also to examine the determining factors which may affect consumer's WTP for renewable energy. The CVM questionnaire consists of four main sections. The first section begins with questions on the socioeconomic and demographic variables including the monthly income, education level, age, gender, number of children, and number of household members. The second section requires information regarding the respondent's current energy consumption, concern about climate change, concern on energy resource constraint, and general knowledge about renewable energy sources. The third section of the survey questionnaire focuses on the valuation part. Questions in this part begin with an information on the existing policy of renewable energy related to the Renewable Energy (RE) Fund (KWTBB), where Tenaga Nasional Berhad (TNB) collects the fund on behalf of the government. The fund was established under Section 23, RE Act 2011. Consumers' electricity consumption is measured as the consumers' electricity bill and collected by the government to fund the RE Fund (KWTBB). The fund will be ultimately channelled to the government. The process is administered by a governmental body known as SEDA that is held responsible to monitor the whole FiT system**.** The details of this section can be seen in Text Box 1.

In what follows, the dichotomous choice questions were designed to ask the respondents (after the description of a hypothetical scenario) on their willingness to pay for renewable energy. In particular, the respondents were

Text Box 1. Contingent Valuation Scenarios

Generating electricity from renewable energy resources is one of the efforts to diversify the energy resources in the country. Sustaining the natural resources is an integral part of our duty in order to ensure continuous benefit for the future generations. Hence, prudent usage of natural resources such as gas, coal, and oil must be fostered.

Ensuring the sustenance of the natural fossil fuels reserves prompted the establishment of the RE Fund (KWTBB) that is founded by the RE Act 2011. The RE Act 2011 enforces 1.6% surcharges on consumer's electricity consumption that shall be channelled to the RE Fund (KWTBB). However, the surcharge is only applicable to monthly consumption exceeding 300kw.

Despite SEDA's success to collect RM600 million for the RE Fund from the levy in 2014, the amount is insufficient to cater the RE projects. Henceforth, the 1.6% levy is proposed to be increased as the current level is incapable to provide the necessary fund for RE project and development.

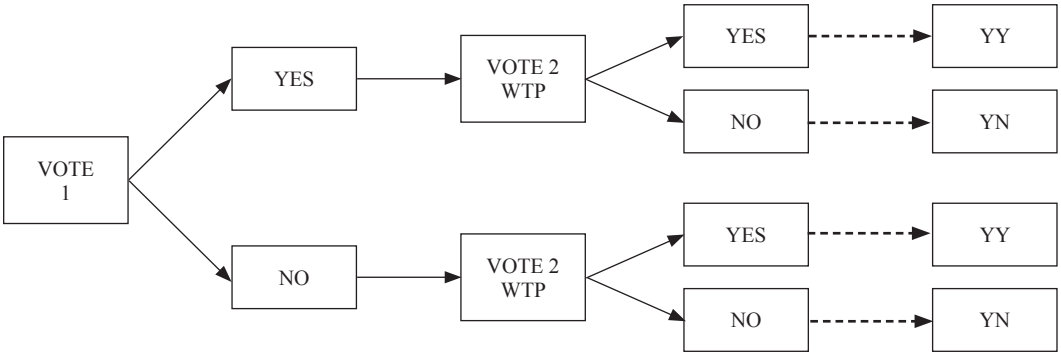

FIGURE 1. Double Bounded Dichotomous Choice (DBDC) Questioning involving DBDC Bid Price

asked whether they would be willing to pay additional percentage (%) on their electricity bill to promote growth of electricity generation from renewable energy resources. If the respondents respond "yes" on the first round, the second proposed bid will be increased. If they respond "no" on the first bid, the second proposed bid will be proposed to a smaller amount. Accordingly, the double-bounded CVM produces four possible outcomes such as "yes/yes" (YY), "yes/no" (YN), "no/yes" (NY) and "no/no" (NN) (See Figure 1).

To avoid the possible starting point bias, the survey questionnaire proposed different price bids. In specific, this study offers three groups of proposed price bid which comprise a 2% increase and decrease of the 1.6 % levy from the respondent's electricity bill. According to Alberini (1995), there is no accepted statement in the previous works on the number of different bids offered in the CVM studies. However, efficiency of the median WTP estimates can be improved by incorporating lesser and different bid values. Accordingly, the price bids that were presented to the respondents are shown in Table 1.

TABLE 1. Hypothetical price bid offers

Initial Offer		Higher Price Bid		Lower Price Bid	
(RM)	(%)	(RM)	(%)	(RM)	(%)
RM 1.54	2	RM 3.08	4	RM 0.77	1
RM 3.08	4	RM 4.62	6	RM 1.54	2
RM 4.62	6	RM 6.16	8	RM 3.08	4

A pre-test was conducted in January 2016 on 30 respondents in Kuala Terengganu, whereby the results from the pre-test were used to constitute the percentage and bid point increments. The pre-test is necessary to ensure the comprehension of the questionnaire (Zikmund 2000). The pre-test was also conducted to overcome ambiguous and vague questions which are common features of hypothetical bias in CV bias. Such hypothetical bias may arise if the respondent provides answer that does not illustrate the real choice. Translating the hypothetical scenarios into *Bahasa Malaysia* and direct explanation by the enumerators were the precautionary steps taken in this study to minimise the possibility of hypothetical bias.

DOUBLE-BOUNDED DICHOTOMOUS CHOICES (DBDC)

This study employed the double-bounded CVM approach as it demonstrates follow up questions from a conventional method which is the single bounded CVM approach. The method is capable to improve efficiency of the questionnaires (Chien *et al.,* 2005). The aim of CVM is to produce valuations that closely resemble the outcomes of an actual market. It has been confirmed with theoretical findings by Calia and Strazzera (1999) that double bounded CVM generates more precise point estimates of parameters and central tendency measures of willingness to pay, along with narrower confidence intervals mean or median of willingness to pay.

This study applies the CVM approach with closed-ended format in order to estimate residents' WTP and also increase the efficiency of the estimated variables of WTP (Hanemann et al. 1991). An individual can be proposed twice and followed up with the second rounds of proposed bids in the double bounded CVM. This method is first proposed by Hanemann (1985), in which an individual has to respond to the first bid and enters the second bid with a new suggested price bid. The proposed price bid in the second round relies on the "yes" or "no" answers in the first round. This method comprises of starting point bias because of respondents' replies on the second bid may be influenced by the first proposed price bid (Flachaire & Hollard, 2005). The method generates discrepancy between answers on the first and second bids. Such bias signals weak definition and perception of the subject among the respondents. Chien et al. (2005) highlighted the various methods to minimise the starting point bias. Two main approaches have been proposed by past literature, whereby the first approach requires designing better CVM questionnaires and surveys. In the second approach, proper model should be established with clear estimation on the potential effects and bias arising from the dichotomous valuation.

The mathematical component of the double-bounded CVM (DCVM) is a direct extension of the single-bounded CVM model (Kanninen & Khawaja, 1995). Model formulation for the double-bounded CVM thoroughly followed Hanemann *et al.,* (1991). The second round answers generate four results such as, , and The probabilities of answers to both the initial and the follow-up WTP questions are as follow;

$$Pr_i^{YesYes}\ (1^{st}\ \text{BID, HBID}) = \text{Prob}\ \{1^{st}\ \text{BID} \leq \text{WTP}_{max}\ \text{and}\ \text{HBID} \leq \text{WTP}_{max}\} \quad (2)$$

$$Pr_i^{NoNo}\ (1^{st}\ \text{BID, LBID}) = \text{Prob}\ \{1^{st}\ \text{BID} > \text{WTP}_{max}\ \text{and}\ \text{LBID} > \text{WTP}_{max}\} \quad (3)$$

$$Pr_i^{YesNo}\ (1^{st}\ \text{BID, HBID}) = \text{Prob}\ \{1^{st}\ \text{BID} \leq \text{WTP}_{max} \leq \text{HBID}\} \quad (4)$$

$$Pr_i^{NoYes}\ (1^{st}\ \text{BID, LBID}) = \text{Prob}\ \{1^{st}\ \text{BID} \geq \text{WTP}_{max} \geq \text{LBID}\} \quad (5)$$

The above equations describe if respondent replies "yes" by accepting the price on the first bid (1^{st} BID) and the second bid presents a higher bid (HBID) than the initial bid is 1^{st} BID < HBID. On the other hand, if respondent replies "no" to the initial bid, the second bid is lower (LBID) than the initial bid, so it demonstrates 1^{st} BID > LBID. The probabilities for the dichotomous choice double bounded CVM for log-logistic model in this study is as follows;

$$Pr_i^{YesYes} = [\ 1 + e^{-(\alpha + \beta \text{HBID})}]^{-1} \quad (6)$$

$$Pr_i^{NoNo} = 1 - [\ 1 + e^{-(\alpha + \beta \text{LBID})}]^{-1} \quad (7)$$

$$Pr_i^{YesNo} = [1 + e^{-(\alpha + \beta \text{HBID})}]^{-1} - [1 + e^{-(\alpha + \beta 1\text{stBID})}]^{-1} \quad (8)$$

$$Pr_i^{NoYes} = [1 + e^{-(\alpha + \beta 1\text{stBID})}]^{-1} - [1 + e^{-(\alpha + \beta \text{LBID})}]^{-1} \quad (9)$$

The mean WTP of application DCVM is estimated as the area under the probability function of accepting the price bid by using integration technique as shown below;

$$\text{E(WTP)} = \int (1 + e^{a+bWTP})^{-1} db_L^U \quad (10)$$

where $(1 + e^{a+bWTP})^{-1}$ presents the probability of saying yes and upper (U) and lower (L) limits of the integration. The mean WTP is calculated as follows;

$$\text{E(WTP} \mid \bar{x}, \beta) = \bar{x}' \left[-\frac{\hat{\alpha}}{\hat{\delta}} \right] \quad (11)$$

This study also comprises covariates, α is a linear function of the covariates, instead of the intercept, where $\alpha = \bar{x}$, $\hat{\beta}$. $\bar{x}$ demonstrates the vector of interest for explanatory variable and $\hat{\beta}$ is the vector of Maximum Likelihood estimates of the parameters (Calian & Strazzera 1999).

DATA DESCRIPTION

The data contain observations on 411 randomly selected respondents. The structure of the data is divided into two types of discrete choice or outcome. First, it involves dichotomous or binary variables which take on a value of one or zero depending on which of two possible results occur. For an example is the gender variable. Secondly is the polychotomous variables which take on a discrete number that is greater than two of possible values. The level of educational attainment is an example of a special case of an ordered variable, which is a sequential variable that occurs when the second event is dependent on the first event. The descriptive statistics and brief description of the socio-economic characteristics of the respondents are provided in Table 2. HINC refers to household income and is measured in RM/monthly. Educational achievement (EDU) is measured on a scale from 1 to 5 (=1 for no formal education; = 2 for elementary school level; = 3 for high school level; = 4 for undergraduate studies and = 5 for a master's or doctoral degree. FEMALE refers to 1 if the person is a female and 0 otherwise. CHILD is the number of children, HHSIZE is the number of household, and HAREA is the immensity of the residential area and measured in m^2.

The average household income of respondents was RM2618.39. The respondents' average education level was high school. Fifty-four percent of the respondents were female. On average, the respondents have 4 children and the number of household members living together was 6 persons.

RESULTS AND DISCUSSION

The distribution of respondents' responses to the valuation questions is presented in Table 3. The table indicates the total number of respondents who were willing to pay for the renewable energy sources at three bid levels ranging from RM1.54, RM3.08 and RM4.62 per month. Almost 66.91% of those interviewed answered 'no' to

TABLE 2. Descriptive statistics for socio-economics and demographic variables.

Variable name	Description and measurement	Mean	Std.Dev.	Min	Max
HINC	Household income (RM)	2618.39	2991.89	2000	50000
EDU	Education (1 to 5 scale)	3	1	1	6
FEMALE	= 1 if female; = 0 if male	0.54	0.5		
CHILD	No. of children	4	3	0	12
HSIZE	No. of household members	6	2	0	19
HAREA	Immensity (m^2)	1333.73	658.37	102	5000

TABLE 3. Respondents' 'Yes' and 'No" responses to the WTP questions for different payment vehicles

Bid	No (%)	Yes (%)
1.54	52.52	47.48
3.08	63.70	36.30
4.62	84.67	15.33
Total	66.91	33.09

the first contingent valuation question and only 33.09% answered 'yes'. It is important to note that as the bid increases, the number of individuals that answered 'yes' to the first bid amount goes down. For instance, 47.48% respondents were willing to contribute RM1.54, whereas only 36.30% and 15.33% preferred the RM3.08 and RM4.62, respectively. In total, 136 respondents (33.09%) of the sample voted 'yes' to the asked bid amount, and 275 (66.91%) respondents voted 'no'.

Table 4 presents the estimation results for the WTP of renewable energy in both single bounded and double bounded models. All parameters are significant with exception of the education. In the two models, the offered bid is statistically significant. The single bounded model yields an estimated coefficient of –0.3169 while the bounded model reported and estimated coefficient of –1.480. Being the strongest determinant of WTP, an increase in bid price reduces the probability of residents' WTP for renewable energy. This result is consistent with the economic theory and suggests the probability of declining 'yes' response with an increase of offered bid value. This result is consistent with the study of Arega and Tadesse (2017) in Northen Ethiopia and Guo et al. (2014) in China.

As expected, WTP for renewable energy can be explained by household income. In both models, it is observed that WTP for renewable energy increases with higher levels of income. The result implies respondents with higher income are found to be more likely to answer 'yes' to the valuation questions. This finding is in line with earlier research. Study by Guo et al. (2014) in China, Zoric´and Hrovatin, (2012) in Slovenia, Mozumder et al. (2011) in the USA, and Yoo and Kwak (2009) in Korea found parallel results on the positive effect of income on WTP.

TABLE 4. Estimation results of single and double bounded dichotomous choice probit models

Variables	Coefficients (Single bounded)	Coefficients (Double bounded)
Bid Price	–0.3169(0.000)***	–1.4801(0.000)***
Household Income	0.1926 (0.060)*	0.4090 (0.0007)***
Education	0.0626(0.426)	0.0496(0.792)
Constant	–1.1587 (0.098)*	–2.4748 (0.0073)*
Mean WTP	1.5736 (0.001)***	3.2182(0.0057)***

Notes: Numbers in parentheses are p-value. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

With respect to the value of WTP, the single bounded model yields an estimated mean of RM1.57 (USD0.40) and the *p*-value is at 0.001. Hence, one can reject the hypothesis that the mean WTP is statistically different from zero at the 1% level of statistical significance. Nevertheless, the double bounded model yields an estimated mean WTP of RM3.22 (USD0.82) and an estimated *p* -value of 0.0057. Accordingly, it is concluded that the mean WTP is not different from zero and the hypothesis can be rejected.

CONCLUSION

Climate change, resource depletion and energy security have become one of the major environmental problems that adversely affects the world. In order to ease the effects of these problems, Malaysia is trying to use more environmental-friendly energy sources. It has emerged as a solution to reduce greenhouse gas emission, fight climate change, improve energy security and lower the dependence on fossil fuels. Accordingly, the Malaysian government aims to achieve 11% of electricity supply from renewable energy by 2020. Nevertheless, this target that should be achieved through the implementation of various energy policy measures has become a crucial challenge for Malaysia. The rough implementation is caused by the strong dependency of the feasibility and effectiveness of any policy to attain this target on both the producers and consumer's valuation of renewable energy program.

This paper attempts to investigate consumers' WTP for renewable energy and identifies factors influencing consumer's preferences with special attention to Malaysia setting. The CV method was used to obtain estimates of the WTP. The finding of this study reveals that the decision on WTP primarily depends on price and household income. The bid price is negatively related to willingness to pay for renewable energy while income showcases positive relation. As Malaysia is moving towards a higher income nation status, the finding indicates that consumers are willing to pay for renewable energy in parallel with consumer's income. Thus, relevant utilities companies may alter their business strategy to aim consumers with higher earnings, in order to increase monetary funding for an increase in the market share of renewable energy. In contrast, education has no significant effect on the WTP for renewable energy. Although it may seem surprising to find education as insignificant and positively related with the WTP, but it should be noted that the population in Terengganu does not correspond the whole population in Malaysia. Hence, Malaysian government and other related agencies should further

educate the public about the importance of renewable energy resources in nowadays energy consumption. It is expected that increased knowledge of consumers will surge the support of renewable energy strategies. With regards to the value of the mean WTP, it is calculated at RM1.57 (USD0.40) and RM3.22 (USD0.82) per person for the single bounded and double bounded models, respectively. The mean WTP value for the double bounded CVM model was higher than those of the mean WTP single bounded model. Nevertheless, the reported mean WTP for renewable energy in Malaysia is considered low compared to other countries.

In order to formulate action and plan the appropriate for the short, medium or long-term renewable energy projects, relevant policy makers may take into considerations of the above results. However, the results from this study are not generalisable as they may not be applicable to the entire Terengganu area and Malaysia as a whole. This fact shows there is a great opportunity for future research to address the issues by introducing clean energy sources to the residents living in more developed states of Malaysia which can be assumed to pay more for renewable energy. Further investigation should be conducted to validate these results. Nonetheless, the findings can be beneficial for the policy makers as paying attention to the consumers' level may act as the starting point in understanding the benefits of introducing the renewable energy to this target group. The findings may serve a way towards the following phases in the area regarding WTP for renewable energy in Malaysia.

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